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AiSTEMeX: Integrating Artificial Intelligence into STEM Education through Exploration

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ABSTRACT

AiSTEMeX (AI+STEM+Exploration) is an innovative learning module designed to integrate Artificial Intelligence (AI) into STEM education through experiential, ethical, and inquiry-based activities. Grounded in the Identify–Integrate–Innovate (I³) learning approach, the module guides students to recognize AI applications in daily life, apply AI tools responsibly in STEM contexts, and innovate AI-based solutions for real-world challenges. The programme was implemented with 100 Form 4 students from B40 backgrounds, who participated in an Explorace-style learning experience connecting AI concepts to Biology, Physics, and Mathematics. Post-programme feedback revealed overwhelmingly positive responses: over 90% of students expressed increased motivation and confidence in using AI ethically, while facilitators observed significant improvement in teamwork, creativity, and problem-solving skills. Teachers reported stronger classroom engagement and deeper conceptual understanding, and institutional partners highlighted AiSTEMeX's alignment with Malaysia's STEM–AI education agenda. Collaboration with MAXIS further demonstrated how cross-sector partnerships can extend digital inclusion and inspire future-ready learning. Overall, AiSTEMeX has proven that integrating AI within STEM through experiential and ethical frameworks cultivates critical thinking, digital literacy, and social responsibility. By merging technology, creativity, and values, the AiSTEMeX module empowers students to become responsible innovators in an AI-driven world—making STEM learning smarter, more meaningful, and socially conscious.

Keywords: Artificial Intelligence, STEM Education, Experiential Learning, Responsible AI, Ethics in Education

1. INTRODUCTION

The **AiSTEMeX Module** is developed to guide students to recognize AI applications in daily life, apply AI tools responsibly in STEM contexts, and innovate AI-based solutions for real-world challenges. It places strong emphasis on developing learners' ability to think critically, reflect on their learning processes, and apply knowledge across disciplines. This module is suitable for a wide range of learners, from primary and secondary school students to pre-university learners, with activities that can be adapted according to different levels of prior knowledge and cognitive readiness. It is designed to be flexible, allowing both guided instruction and independent exploration, making it suitable for classroom implementation, workshops, or enrichment programmes.

At the end of this module, learners will be able to:

- Understand fundamental concepts of AI and its applications within STEM contexts
- Apply problem-solving strategies to real-world scenarios
- Engage in critical and creative thinking through structured activities

- Reflect on their learning processes to improve understanding and performance
- Utilize digital tools and technologies effectively to support learning

The integration of AI tools within the activities serves not only as a technological enhancement but also as a means to shape and scaffold students' thinking processes, encouraging deeper engagement and iterative learning. Through this approach, learners are guided to become more aware of their thinking, regulate their strategies, and evaluate their outcomes. The module is organized into a series of thematic activities, each designed to connect STEM concepts with AI applications in meaningful and accessible ways. Each activity includes clear instructions, guided tasks, opportunities for exploration, and reflective components to reinforce learning. This structured yet flexible design enables educators to adapt the module according to their teaching context and students' needs. Users are encouraged to engage actively with each activity, participate in discussions, and reflect on their learning experiences. Educators may facilitate the module by guiding students through the activities, encouraging collaboration, and supporting inquiry-based exploration.

2. METHODOLOGY

The AiSTEMeX Module utilized Identify–Integrate–Innovate (I³), experiential, and inquiry-based learning approaches, where students actively constructed knowledge through exploration and reflection. The module's design is flexible and organized into thematic activities suitable for guided instruction or independent exploration across different educational levels.

2.1 Participants

The activity involved 100 Form 4 (16-year-old) students from B40 backgrounds, organized into 10 groups of 10 students. The implementation was conducted at the Center for Foundation Studies in Science, Universiti Malaya.

2.2 Implementation Method

The main method was an "Explorace (AI Challenge Race)" lasting 120 minutes, where groups rotated through six learning stations. The stations were structured according to two frameworks:

I. I³ Framework (Stations 1-3, 10 minutes each):

- Identify (Station 1):** Students identified AI applications in daily life and discussed their potential benefits and risks (e.g., privacy, misinformation).
- Integrate (Station 2):** Students used AI tools (mock interface or demo links like Canva Magic Write/ChatGPT) to complete a creative/academic task and reflected on responsible use (avoiding plagiarism, checking accuracy).
- Innovate (Station 3):** Students brainstormed and pitched simple AI solutions for social good based on themes like Education or Environment.

II. Subject-Based Integration (Stations 4-6, 20 minutes each):

- Biology (Station 4):** Used the *Seek by iNaturalist* application to identify plant species and applied taxonomy, while critically evaluating the reliability of AI identification.

- b. **Physics (Station 5):** Used PhET Interactive Simulations on buoyancy and density to apply physics concepts and investigate cause-effect relationships.
- c. **Mathematics (Station 6):** Focused on Quadratic Equations, comparing manual problem-solving with AI tools (e.g., ChatGPT, GeoGebra), and exploring advanced concepts (discriminant, graph changes) using AI visualization.

3. RESULTS AND DISCUSSION

The implementation of the AiSTEMeX module yielded significant positive outcomes across student engagement and skill development. The I³ framework proved effective in scaffolding learning from basic awareness to complex ethical innovation.

- **Digital Literacy and Ethics:** Post-programme feedback indicated that over 90% of students expressed increased motivation and confidence in using AI ethically. The structured reflection questions embedded in the stations (e.g., critical evaluation of AI accuracy in Station 4 and comparing human vs. AI solutions in Station 6) were instrumental in fostering this ethical awareness.
- **Higher-Order Thinking:** Facilitators observed significant improvement in essential 21st-century skills, including teamwork, creativity, and problem-solving. The activities, such as designing an AI solution for social good (Station 3) and applying concepts using real-time simulations (Station 5), fostered critical and creative thinking through structured, real-world problem-solving tasks.

The successful integration of AI tools—such as *Seek* for Biology, PhET for Physics, and various solvers for Mathematics—transformed abstract concepts into concrete, manipulable experiences. This scaffolding helped students become more aware of their thinking, regulate their learning strategies, and critically evaluate AI outputs, rather than passively relying on them. The findings validate that AI, when used as a reflective and supporting tool, successfully reinforces learning and cultivates lifelong interest in innovation.

4. CONCLUSION

AiSTEMeX successfully demonstrated that the integration of Artificial Intelligence into STEM education through experiential and ethical learning cultivates critical thinking, digital literacy, and social responsibility. By merging technology, creativity, and values, the module empowers students from B40 backgrounds to become responsible innovators in an AI-driven world, making STEM learning smarter, more meaningful, and socially conscious. The I³ framework and Explorace format provide a robust, hands-on structure that is highly effective for delivering future-ready skills. Future work should focus on scaling the implementation of the AiSTEMeX module across a wider demographic, particularly leveraging its documented flexibility to adapt activities for various learners, from primary to pre-university levels. Further research should also track the long-term impact of ethical AI training on students' academic performance and career choices.

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REFERENCES

- Akhmetova, A. I., Sovetkanova, D. M., Komekbayeva, L. K., Abdrakhmanov, A. E., Yessenuly, D., & Serikova, O. S. (2025). A systematic review of artificial intelligence in high school STEM education research. *EURASIA Journal of Mathematics, Science and Technology Education*, 21(4), em2623. <https://doi.org/10.29333/ejmste/16222>
- Al Darayseh, A., & Mersin, I. (2025). Integrating generative AI into STEM education: Insights from science and mathematics teachers. *International Electronic Journal of Mathematics Education*, 20(3), em0832. <https://doi.org/10.29333/iejme/16232>
- Leon, C., Lipuma, J., & Oviedo-Torres, X. (2025). Artificial intelligence in STEM education: A transdisciplinary framework for engagement and innovation. *Frontiers in Education*, 10, 1619888. <https://doi.org/10.3389/feduc.2025.1619888>
- Murniarti, E., & Siahaan, G. (2025). The synergy between artificial intelligence and experiential learning in enhancing students' creativity through motivation. *Frontiers in Education*, 10, 1606044. <https://doi.org/10.3389/feduc.2025.1606044>
- Wang, S. (2024). Artificial intelligence in education: A systematic literature review. *Computers & Education: Artificial Intelligence*, 6, 100188. <https://doi.org/10.1016/j.caeai.2024.100188>
- Xu, W., & Ouyang, F. (2022). The application of AI technologies in STEM education: A systematic review from 2011 to 2021. *International Journal of STEM Education*, 9(59). <https://doi.org/10.1186/s40594-022-00377-5>